

XINYU (NORAH) TAN

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EDUCATION

Massachusetts Institute of Technology

Sep. 2022 – May 2027 (expected)

Ph.D., Mathematics

- Advised by Aram Harrow and Peter Shor.

Duke University

Aug. 2018 – Dec. 2021

B.S., Double Major in Mathematics and Computer Science

- Advised by Robert Calderbank and Jianfeng Lu.
- Graduated with Highest Distinction in both Mathematics and Computer Science.

RESEARCH INTERESTS

Quantum information and computation, focusing on:

- Random circuits and unitary designs
- Quantum algorithms: quantum learning theory, circuit compilation, and Gibbs sampling
- Quantum error correction and fault tolerance

PUBLICATIONS & PREPRINTS

Authors are listed in alphabetical order. Exceptions are noted explicitly.

1. **Random dimension reduction and learning symmetric properties of quantum states**
Angus Lowe and **X. Tan**
Preprint
2. **Rapid mixing for high-temperature Gibbs states with arbitrary external fields**
Ainesh Bakshi and **X. Tan**
Preprint
3. **Haar random codes attain the quantum Hamming bound, approximately**
Fermi Ma, **X. Tan**, and John Wright
QIP 2026
4. **Unitary synthesis with fewer T gates**
X. Tan
PRX Quantum (2026)
TQC 2026
5. **Characterization of permutation gates in the third level of the Clifford hierarchy**
Zhiyang He, Luke Robitaille, and **X. Tan**
TQC 2026
6. **Beating full state tomography for unentangled spectrum estimation**
Angelos Pelecanos, **X. Tan**, Ewin Tang, and John Wright
SODA 2026

7. **Incompressibility and spectral gaps of random circuits**
Chi-Fang Chen, Jeongwan Haah, Jonas Haferkamp, Yunchao Liu, Tony Metger, and **X. Tan**
QIP 2025, short plenary talk
FOCS 2025
8. **Efficient approximate unitary designs from random Pauli rotations**
Jeongwan Haah, Yunchao Liu, and **X. Tan**
Communications in Mathematical Physics (2025)
FOCS 2024
QIP 2025
9. **Scalable surface-code decoders with parallelization in time**
X. Tan^{*}, Fang Zhang^{*}, Rui Chao, Yaoyun Shi, and Jianxin Chen (*ordered by contribution; * equal contribution*)
PRX Quantum (2023)
QEC 2023, invited talk
Simons Institute Workshop on Advances in Quantum Coding Theory (2024)
10. **Approximate unitary 3-designs from transvection Markov chains**
X. Tan, Narayanan Rengaswamy, and Robert Calderbank (*ordered by contribution*)
Designs, Codes and Cryptography (2022)
11. **Power spectra of constrained codes with level-based signaling: overcoming finite-length challenges**
Jessica Centers^{*}, **X. Tan**^{*}, Ahmed Hareedy, and Robert Calderbank (*ordered by contribution; * equal contribution*)
IEEE Transactions on Communications (2021)
12th Non-Volatile Memories Workshop (NVMW 2021), **Memorable Paper Award Finalist** in the ECC and Devices category

WORK EXPERIENCE

Google Quantum AI

Student Researcher, hosted by Robin Kothari and David Gosset

Playa Vista, CA

Jun. 2026 – Aug. 2026

- Developing quantum circuit compilation algorithms.

Google Quantum AI

Student Researcher, hosted by William J. Huggins

Venice, CA

Jun. 2025 – Aug. 2025

- Developed a Clifford+T synthesis algorithm for arbitrary unitaries with lower T-counts than the 2018 state of the art, resulting in a solo-authored PRX Quantum and TQC 2026 paper.

Alibaba Group U.S. Inc.

Research Intern, hosted by Jianxin Chen

Bellevue, WA

May 2022 – Aug. 2022

- Developed simulation tools for quantum error correction and logical computation on AQL quantum hardware; the project resulted in the 2023 PRX Quantum paper *Scalable surface-code decoders with parallelization in time* (co-first author).

Rhodes Information Initiative at Duke University

Software Engineering Intern, supervised by Ingrid Daubechies

Durham, NC

Jan. 2022 – May 2022

- Built and open-sourced a Python web application for art museums to restore degraded paintings, porting a legacy MATLAB codebase to improve accessibility.

FELLOWSHIPS & AWARDS

- 2026 Phyllis Ruby Block Fellowship, sponsored by the MIT Department of Mathematics.
- 2023 Ida M. Green Fellowship, sponsored by the MIT Office of Graduate Education.
- 2022–2023 MathWorks Fellowship.
- 2022 Computing Research Association (CRA) Outstanding Undergraduate Researcher Award Runner-Up.
- 2022 Julia Dale Prize, Duke Mathematics Department.
- 2022 Excellence in Research Award, Duke Mathematics Department.
- 2022 Alex Vasilos Memorial Award, Duke Computer Science Department.
- 2021 Duke Faculty Scholar, the highest award given by faculty to undergraduates, one of three recipients.

TEACHING & MENTORING

MIT SPUR and UROP

Research Mentor

Cambridge, MA

Summer 2024 – 2026

- Mentored MIT undergraduate Luke Robitaille on the Clifford hierarchy through SPUR (Summer 2024) and UROP (2024–2026); the collaboration resulted in a coauthored TQC 2026 paper.

IAS Park City Mathematics Institute (PCMI)

Graduate Summer School Teaching Assistant

Park City, Utah

Jul. 2023 – Aug. 2023

- Quantum LDPC codes minicourse taught by Nicolas Delfosse.

ACADEMIC SERVICE & LEADERSHIP

MIT Quantum Information Community

Organizer

Cambridge, MA

Sep. 2024 – Jan. 2026

- Secured an MIT School of Science *Quality of Life* grant to fund monthly community events.
- Coordinated weekly group-meeting speakers and logistics (Sep. 2024 – Jun. 2025).

MIT Applied Math Graduate Student Seminar

Organizer

Cambridge, MA

Aug. 2023 – Dec. 2023

- SPAMS, the Simple Person's Applied Math Seminar, happens weekly featuring talks by graduate students on applied math topics.

Duke Undergraduate Quantum Information Society (DuQIS)

Co-founder and co-president

Durham, NC

May 2020 – Dec. 2021

- Co-led a student organization promoting access to quantum information science and research opportunities at Duke; organized workshops, panels, talks, hackathons, and social events.
- Co-instructed Duke's Spring and Fall 2021 half-credit House Course 59, Applied Introduction to Quantum Computing, and the 2021 Duke $\times$ qBraid K–12 Quantum Computing Summer School.